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The accretion environment of supergiant fast X-ray transients probed with XMM-Newton

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Abstract

© ESO, 2017. Context. Supergiant fast X-ray (SFXT) transients are a peculiar class of supergiant X-ray binaries characterized by a remarkable variability in the X-ray domain, widely ascribed to accretion from a clumpy stellar wind. Aims. In this paper we performed a systematic and homogeneous analysis of the sufficiently bright X-ray flares observed with XMM-Newton from the supergiant fast X-ray transients to probe spectral variations on timescales as short as a few hundred seconds. Our ultimate goal is to investigate whether SFXT flares and outbursts are triggered by the presence of clumps, and to reveal whether strongly or mildly dense clumps are required. Methods. For all sources, we employ a technique developed by our group already exploited in a number of our previous papers, making use of an adaptive rebinned hardness ratio to optimally select the time intervals for the spectral extraction. A total of twelve observations performed in the direction of five SFXTs are reported, providing the largest sample of events available so far. Results. Using the original results reported here and those obtained with our technique from the analysis of two previously published XMM-Newton observations of IGR J17544-2619 and IGR J18410-0535, we show that both strongly and mildly dense clumps can trigger these events. In the former case, the local absorption column density may increase by a factor of ? 3, while in the latter case, the increase is only a factor of ~2-3 (or lower). An increase in the absorption column density is generally recorded during the rise of the flares/outbursts, while a drop follows when the source achieves peak flux. In a few cases, a re-increase of the absorption column density after the flare is also detected, and we discovered one absorption event related to the passage of an unaccreted clump in front of the compact object. Overall, there seems to be no obvious correlation between the dynamic ranges in the X-ray fluxes and absorption column densities in supergiant fast X-ray transients, with an indication that lower densities are recorded at the highest fluxes. Conclusions. The spectral variations measured in all sources are in agreement with the idea that the flares/outbursts are triggered by the presence of dense structures in the wind interacting with the X-rays from the compact object (leading to photoionization). The lack of correlation between the dynamic ranges in the X-ray fluxes and absorption column densities can be explained by the presence of accretion inhibition mechanism(s). Based on the knowledge acquired so far on the SFXTs, we propose a classification of the flares/outbursts from these sources in order to drive future observational investigations. We suggest that the difference between the classes of flares/outbursts is related to the fact that the mechanism(s) inhibiting accretion can be overcome more easily in some sources compared to others. We also investigate the possibility that different stellar wind structures, other than clumps, could provide the means to temporarily overcome the inhibition of accretion in supergiant fast X-ray transients.

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Keywords

X-rays: Binaries, X-rays: Individuals: IGRJ16328-4726, X-rays: Individuals: IGRJ17354-3255, X-rays: Individuals: IGRJ17544-2619, X-rays: Individuals: IGRJ18450-0435, X-rays: Individuals: SAXJ1818.6-1703

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